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10 Organisational Behaviour

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**Gaze and Posture in Collaborative Building: A multimodal video analysis of
emergent shared knowledge**

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Gaze and Posture in Collaborative Building: A multimodal video analysis of emergent shared knowledge

ABSTRACT: *This paper reports on analysis from a corpus of audio-video recorded interactions during a collaborative building task. The task generates distinct knowledge asymmetries which motivate interaction toward acquiring shared understandings. The analysis suggests that the convergence of the communicative modes of posture and gaze is crucial to producing shared knowledge. These findings support claims that there are no fixed norms for gaze distribution and postural orientation in interaction, but that these are heavily influenced by the environment and task. Furthermore, the findings suggest participants prioritise producing communicative intersubjectivity over perceptual intersubjectivity. The implications of these findings for the nature of intersubjectivity and research into teamwork are considered.*

Keywords: Group dynamics, Group processes, Interpersonal behaviour, Negotiation, Team processes, Decision making

Knowledge, and processes associated with developing, managing and sharing knowledge have been inextricably linked to organisational operation and competitive advantage (Argote & Ingram, 2000). Drawing on participatory and transactional models of communication (Kastberg, 2014; Scollon, 2001), interactions between staff are seen as a critical site for sharing and creating knowledge (Szulanski, 2000; Tsoukas, 2009). Knowledge transfer or creation by staff is often expected to involve large scale practices, such as a manufacturing or production process (Szulanski, 2000; Zack, 1999), but analysing finer levels of detail is possible and likely to develop insight. Indeed, interactions are replete with subtle moments of intersubjectivity where understanding is shared (Linell, 1998). Although many of these moments are minor in comparison to larger scale organisational process, there is a long history of academic innovation stemming from exploring how people negotiate the most everyday of situations (Garfinkel, 1967). In this paper, we apply a multimodal analytical framework to develop a fine-grained analysis of emergent moments of shared knowledge and show how video analysis and corresponding multimodal theories and methodologies (Hindmarsh & Llewellyn, 2018; Norris, 2004; Norris, Geenen, Metten, & Pirini, 2014; Pirini, 2016; Toraldo, Islam, & Mangia, 2018) can be utilised

in organisational studies to develop new insights regarding materiality and intersubjectivity during knowledge communication.

INTERSUBJECTIVITY, MULTIPLE MODES AND MATERIALITY

A multimodal perspective aligns closely with the sociomaterial interest in organisational research (Hindmarsh & Llewellyn, 2018; Leonardi, 2013; Orlikowski, 2007). The basic premise of sociomateriality, that the material world is inseparably intertwined with the social, is congruent across differing theoretical bases (Leonardi, 2013). This premise aligns with a mediated one adopted by sociocultural scholars (Wertsch, 1998) building on the work of Vygotsky (1978), and adapted further in linguistics (Scollon, 1998) and multimodal interaction (Norris, 2004). All actions are taken to be *mediated actions*, where social actors act with and through mediational means (Wertsch, 1998). The mediated action embeds a tension between the social actor and their historical body (Nishida, 1958), and the mediational means, which have both psychological and material aspects (Scollon, 1998).

In this paper, we analyse the way that groups of three people reach moments of shared knowledge when they are tasked with building a replica of a model out of blocks. Our analysis shows that moments of coordination emerge at key stages throughout the task, where participants confirm that consensus has been reached solving a troublesome block placement. A multimodal approach highlights the multiple modes through which coordinated actions are produced. We find in this task that moments of coordination are exemplified by gaze and postural alignment. Importantly, posture and gaze practices in particular differ from commonly observed maxims (Goodwin, 1980). Drawing on Pirini's (2016) concept of an interactive substrate, and tiers of materiality, these moments of shared posture and gaze provide a material basis for intersubjectivity. We explore below in detail how these moments develop, and in the discussion section we question what kinds of knowledge these modes of posture and gaze offer access to, while also relating our findings back to the literature on gaze practices. However, first, we address the importance of video analysis to progress this type of research, before describing the task setting in detail.

MULTIMODAL VIDEO ANALYSIS AND ACTION

The multimodal theoretical basis we apply here to intersubjectivity requires a suitable approach to data and methodology. Organisational studies exploring social interaction, discourse and dialogue

commonly utilise interviews and observations as empirical methods (Hindmarsh & Llewellyn, 2018). However, while interviews provide access to people's perceptions of their actions, self-reporting on action and action-as-produced are very different things. During interviews people construct meaning through language (Fairclough, 1992), producing their identity (Bauman, 1996), in response to the presence of the researcher (Labov, 1972). In addition, people often have a low level of awareness of their actions. For example, Scollon and Scollon (2000) report interviewing a woman who spoke against using baby talk with infants, all the while using baby talk with a child sitting on her lap. The disconnects between accounts of action, and action, highlight the methodological issues with using interview data as the primary source when seeking to understand the production of action. Observation overcomes some of these issues, by allowing the researcher direct access actions of interest. However, even when researchers take field notes during observations, they can only develop limited granularity regarding actions (Hindmarsh & Llewellyn, 2018).

Video recordings can address some of the challenges faced by interviews and observation. Furthermore, technological developments over the last 10 - 15 years have made digital video recorders cheaper and less intrusive. Video can be transcribed in detail, facilitating a micro level analysis of action. However, video also raises methodological and theoretical challenges (Hindmarsh & Llewellyn, 2018; Luff & Heath, 2012; Toraldo et al., 2018), and a multitude of multimodal approaches have emerged to address these challenges (Bateman, Wildfeuer, & Hiippala, 2017; Jewitt, Bezemer, & O'Halloran, 2016; Pirini, 2017), each with their own take on data collection (Pirini, Norris, & Matelau-Doherty, 2018). We describe the theoretical and methodological approach we take in more detail below.

A MULTIMODAL METHODOLOGICAL APPROACH

We utilise multimodal (inter)action analysis as a theoretical/methodological framework to analyse the video data collected in this project. Norris (2004, 2011, 2013) lays out the basis for multimodal (inter)action analysis, building on mediated discourse analysis (Scollon, 1998) as a theoretical basis. In line with this approach we take mediated action as our unit of analysis and use Norris's (2004) notion of lower and higher-level actions to delineate mediated actions into analysable units. A lower-level action refers to the smallest pragmatic meaning unit of a mode. For example, an utterance is a lower-

level action in the mode of spoken language, and a gaze shift from one point to another is a lower-level action in the mode of gaze. A higher-level action is made up of a chain (or chains) of lower-level actions and has a socially recognisable start and end point. Of course, higher-level actions may therefore be nested within one another. As an example, we can see how different phases of the building task are nested within larger phases, and within the entire task itself.

At times we make reference to attention/awareness of participants and use modal density to determine this phenomenologically (Norris, 2004, 2011; Pirini, 2014). Modal density is a composite measure of the intensity of modes in a higher-level action, and/or the complexity and multiplicity of intersecting modes in a higher-level action. As pointed out above, lower-level actions are defined as the smallest pragmatic meaning unit of a mode, and thus we can determine attention/awareness by analysing the intensity of particular lower level actions (e.g. gaze), and/or the intersection of lower-level actions in any one particular higher-level action (e.g. gaze, object handling, body posture). Higher level actions where the intensity of lower-level actions is high, and the complexity of intersecting modes is high are usually phenomenologically at the focus of a person's attention/awareness. See Norris 2004 for a broader discussion of this concept.

TASK DESIGN AND LAYOUT OF TASK SPACE

The task involves a collaborative building project where participants must re-create a complex Lego structure using variable sources of information. In each task group, three people construct a Lego model to exactly match an abstract replica. During the building process, multiple replica structures are positioned so that from any one seat the view to the left, the right, and straight ahead provides the same perception of a replica model as from any other seat. However, it is impossible for any participant to see the rear of a replica. Participants overcome this challenge by choosing from two of five possible 'assists' which involve taking pictures, turning or breaking apart a single replica structure. Participants must collaboratively decide who is the builder and which "assists" they will select and then they can begin the build process. The builder may not utilise the assists, so needs to rely on communication with the other participants. Three cameras are placed around the space to audio and video record the building process, and participants may not leave their seats during the task.

COLLABORATIVE GAZE AND COMMUNICATIVE INTERSUBJECTIVITY: ANALYSIS OF REPRESENTATIVE SAMPLES

The multimodal (inter)action analysis (Norris, 2004, 2011) of triadic problem-solving sequences during the goal-oriented building task reveals a decisive preference for collaborative gaze and postural orientation as a means to maintain communicative intersubjectivity. The representative data samples discussed herein show that participants display an overt and consistent prioritisation for a convergence of gaze and postural orientation during problem solving sequences. A collective *divergence* of gaze orientation would provide participants with an identical perceptual view-point of the replica structures which are situated within the task space. Given that the building task is contingent on gaining an accurate visuo-spatial understanding of block combinations and placements, the same perceptual view-point could be a great advantage which would simultaneously support intelligibility of the linguistic propositions which are heavily deictic in nature. More specifically, we expect that the accurate comprehension of “the green block to the left of the blue one is sitting on top of the white large one” would be most easily understood if all participants engaged in the interaction could actually see the physical locations and material entities being referenced through the mode of spoken language. However, the analysis reveals ‘orientational following’ whereby participants both individually and collaboratively prioritise *the same* replica structure during problem solving communicative sequences. Within the corpus there are even some cases whereby participants exemplify individual divergence in deictic orientation whereby they may undertake a deictic gesture toward one location, however, allocate postural and gaze orientation in collaboration with other social actors.

In frame 1 of Figure 1, Tom (left) is currently attending to the mobile phone “assist” which includes pictures of the replica structures. This is clearly evidenced through modal complexity built through gaze, body posture, proxemics and object handling. The multiple simultaneous lower-level actions indicate that the phone is in the foreground of his attention/awareness continuum. Chris (middle) and Celia (right) are at this point in mutual gaze and postural orientation toward one another as Celia is confirming the accuracy of the latest block placement through a lower-level action in the mode of spoken language, saying “that looks right to me”. In frame 2, Chris’s lower-level action of gaze alteration toward a replica structure occurs as Tom alters his gaze toward Chris and their model

structure. At this point, in frames 3 and 4, influenced by Chris's gaze alteration which is recognized by Tom, Tom undertakes a lower-level action of gaze alteration followed by a demonstrable postural shift and comes into collaborative orientation with Chris. Both social actors are clearly focused on the replica structure to the right of Tom. Simultaneously, Celia alters her gaze orientation twice: first to the replica structure which is in front of her and then back to Chris. In frame 5, Tom and Celia both shift their gaze again toward the replica structures in front of them conceivably hoping to confirm the accuracy which Chris has confirmed through spoken language in frame 4 saying "that looks right to me as well". In frame 5, all social actors are divergent in their gaze and postural orientations, all looking at the structures which are located in front of them. In frame 6, Tom interjects signalling that he has perhaps recognized an incongruity saying "but if you". Simultaneously, he alters his gaze and posture, coming once again in collaborative orientation with Chris. Tom's interjection catches Celia's attention who in frame 6 has altered her gaze toward Tom. Recognizing the potential infelicity which was indicated by Tom and recognizing his postural and gaze orientation toward the replica to his right, Celia alters her gaze which includes a slight postural shift evidenced in the drop of her right shoulder, presumably kinaesthetically facilitating the gaze alteration which co-occurs with head movement. At frame 7, all social actors come into collaborative orientation which is evidenced through gaze and posture, all allocating focus to the replica structure which is to the right of Tom. As Tom acknowledges his potential misperception saying "oh ya" followed by "no that looks right" in confirmation of the other social actors' position, Tom reallocates his gaze toward Chris who reciprocates in mutual gaze and postural orientation.

[INSERT FIGURE 1 HERE]

The multiple lower-level actions unfolding indicate a collaborative effort to confirm the accuracy of the most recent block placement during the building task. Each social actor, at different times, appears to confirm this accuracy through the mode of spoken language, though Tom is unsure at first. Paramount in the data segment is how gaze and postural orientation of the social actors is mutually influential as they seek a position of shared knowledge and understanding which will allow them to move forward in the build process. Celia's affirmation through the mode of spoken language motivates a gaze alteration by Chris in an attempt to confirm this position. At this point, Tom also reorients

toward the same structure becoming orientationally aligned as he too must confirm accuracy so the group can come to a position of shared knowledge. By frame 7, Celia recognizes the other social actors' orientation to the same replica structure and additionally alters her own postural and gaze orientation in that direction. Celia and Chris have already provided affirmative confirmation of accuracy, however, Tom's direction of orientation coupled with his negative interjection motivate collaborative orientation toward the structure to Tom's right. The other social actors seem to recognize some locus of information evidenced by Tom's gaze and postural orientation and as a result, come into collaborative orientation toward this replica structure. Even though collaborative orientation will not provide access to the locus of information which is causing apprehension for Tom, the collaborative focus on a single replica structure indicates that they are communicatively aligned with Tom. In other words, in order to follow Tom's thought process, the others appear to prioritise collaborative orientation with a focus on the general locus of information (the replica) rather than on the information source itself (Tom). This collaborative orientation which persists throughout the corpus appears central to the establishment and maintenance of communicative intersubjectivity. While perceptual intersubjectivity is possible and available, social actors appear to prefer communicative alignment or communicative intersubjectivity over perceptual. Reasons for this are explored in more depth in the discussion section.

Another representative data sample involving collaborative gaze and postural orientation as an interactive strategy prioritising communicative over perceptual intersubjectivity is evidenced in Figure 2. Here, social actors are collaboratively trying to determine the placement/location/connection of a specific block on their structure. In frame 1 of Figure 2, Dan (centre) breaks the triadic instructional exchange asking "Yeah but how are they attached". Previous instructional discourse is unproblematic to this point, until the particular connection method is lexicalised is an 'issue' which needs resolution. At the moment of problem introduction, Jim (Left) and Craig (Right), the building assistants have diverging gaze and postural orientations. Jim is evidently focused on the building pieces on the builder's desk while Craig is resolutely oriented toward the model structure in the foreground of the frame. The lower-level action in the form of a spoken interrogative does little to attract the current orientation of the building assistants. The seamlessness by which problem introduction occurs without

further exploration or probing on behalf of the assistants suggests the logic of the question is intuitively understood by the participants. This may be due in part to the fact that method of connection is a key instructional ingredient in much of the directive discourse but is demonstrably evidenced by the lack of clarification required (i.e. What do you mean how are they attached? Which portion are you asking about etc.).

[INSERT FIGURE 2 HERE]

The resulting higher-level action involves dramatic postural and gaze shifts and alterations to and from various replica structures and the pieces in question sitting on the builder's desk. Craig also initially seeks clarification using additional pictures of the replica on a mobile phone and then immediately begins to seek the relevant information from the various replica structures which are available. In frame 5 of Figure 2, the assistants investigate the builders current block location in response to further confirmation requested by the builder who asks "like this I" in frame 3 and "like this right" in frame 4. In frame 6, Jim seeks confirmation visually by a dramatic postural alteration and gaze shift away from the builder's desk and toward one replica structure. Attempting to confirm the visual similarity, the builder elevates the portion of structure which has been completed so as to compare it with replica structure to which his gaze is directed. This shift in orientation is followed by Craig who begins seeking perceptual self-confirmation as well by comparing the finished portion to the replica structure just off screen to the left (the same replica attracting the builder's gaze and postural orientation).

As the nested higher-level action unfolds, multiple coordinated lower-level actions in the form of postural and gaze shifts occur as the participants work seeking knowledge about the method of connection between the two blocks in question. In frame 10, the social actors converge in their gaze orientation to the replica structure located to the right, just out of frame. At the next complete collaborative convergence point in frame 14, the builder signals tentative assurance regarding the accuracy of placement in a lower-level action through the mode of spoken language suggesting "I think its correct". Maintaining convergence of gaze and posture on the same replica, Jim confirms the accuracy of connection which has just "now" been established saying "yeah right now". In frame 15, Craig undertakes multiple lower-level actions, altering posture, proxemics to desk and gaze direction while then immediately following with affirmation through the mode of spoken language saying

“yeah” immediately following the triadic convergence of gaze and posture to the single replica structure.

In Figure 2, the bi-directional influence of postural and gaze orientation alongside orientational following amongst all social actors is clearly evident at multiple points during the interaction. In frame 2, Dan’s lower-level action through the mode of spoken language indicates ambiguity regarding placement. The modal complexity of posture, gaze direction, object handling and spoken language suggests that the replica is in the foreground of Dan’s attention/awareness. Jim responds to Dan’s interrogative by immediately coordinating his own postural and gaze orientation toward the replica structure in the left of the frame. In frame 7, influenced by Dan’s comparative gaze, posture and object handling, Craig undertakes multiple lower-level actions in the form of gaze alterations between the replica, the model itself and back to the replica from frames 7 to 9. At this point, Jim becomes aware of the other social actors converging orientation resulting in a gaze alteration and postural shift coming into orientational convergence with the others. In frame 11, there is a slight divergence as Craig remains oriented toward the replica but all social actors converge again collaboratively in frame 15 which immediately precedes multiple confirmations of accuracy through the mode of spoken language on behalf of each social actor.

DISCUSSION AND DIRECTIONS FOR FUTURE RESEARCH

Paramount in the two representative samples from the corpus are the ways in which the attentive orientation exemplified through postural and gaze direction affects the orientation of other social actors resulting in orientational convergence. As stipulated earlier, given the specific nature of the task and in line with Argyle and Graham (1976), material entities and objects attract gaze as they function as information loci in the task structure. However, the influence of the organisation of the task also results in a dramatically reduced mutual gaze which is typically one cornerstone convention of face-to-face interaction (Goodwin, 1980) as it signals communicative attentiveness to the ongoing talk at hand. The interactional goal established by the task led to a preference for collaborative orientation through the modes of posture and gaze. The two rules Goodwin proposed about gaze in face-to-face interaction, namely “A speaker should obtain the gaze of [their] recipient during the course of a turn -

at – talk (1980, p. 275) and “recipient should be gazing at the speaker when the speaker is gazing at the hearer” (1981, p. 57) do not appear applicable across interaction types.

Objects and artefacts not only attracted attention within the course of the unfolding task, gaze and postural alterations which momentarily indicate alterations of attention/awareness through modal density (Norris 2004, 2011), were not only acceptable by all social actors but often times expected. Thus, the gaze alterations in the form of withdrawals from each other and toward model structures or assists were not only considered ‘less sanctionable’ but actually not sanctionable at all. Rossano (2012) aptly suggests that gaze is employed in response to and in service of the current course of activity. Our analyses generally confirm this idea; however, this should be refined to acknowledge that it is not just current course of activity, but rather, the precise nature of lower-level action (Norris 2004) at specific site of engagement (Scollon 1998; Norris 2011) acknowledging the influence of spatial arrangements, cultural tools, practices and communicative goals.

While participants regularly diverge in their gaze direction as a means to ‘collect’ information or confirm the accuracy of contributions from other team members, penultimate process moments which precede a new task phase (new block placement/reorganisation etc.) are characterised by a multiparty convergence of gaze and mutual confirmations indicating that shared knowledge has been reached. Collective gaze toward a single replica structure which characterises these moments is a peculiar phenomenon due to the precise spatial organisation of the task structure. Gaze divergence provides participants with concrete and material visual intersubjectivity which ought to be a priority when establishing shared understanding of a material and visual structure. The way that participants diverge their gaze during problem sequences indicates that ‘similar perspectives’, i.e. achieved by looking away from one another, provide an important locus of information. However, reunification of collaborative gaze appears paramount in establishing shared knowledge. Thus, a collaborative establishment of communicative intersubjectivity indicated by gaze and postural convergence on “the same” structure appears instrumental in establishing shared knowledge and thus, in the progression to a new problem-solving phase.

These findings inform us about what people prioritise when working together to complete a task that requires multiple moments of shared understanding. At a high level of abstraction this

characterises many organisational tasks, although further work is required before any kind of generalisation is possible. Important in our findings here is the way that knowledge is produced through co-ordinated action. We have described the coordination here as a convergence of gaze and posture. Drawing on Pirini (2016) we argue that coordinating gaze and posture provides a similarity or constancy to the material environment for these social actors, which produces a material basis for intersubjectivity. The nature of this material basis of intersubjectivity is important for understanding what participants prioritise to complete the task. We have argued that the material basis is not a perceptual one, where participants seek to gain the same visual perspective of a replica, but rather a communicative one, where participants converge their gaze upon the same object. This strikes us as an attempt to gain a single perspective, or indeed, as we have argued, a moment of shared knowledge, whereby the perspective of any one member is not paramount, but the moment of combined knowledge facilitating movement towards the next problem phase.

One question that arises is why participants do not look to one another to confirm shared knowledge, but rather look to the same object. Further work to explore more precisely what leads to converging gaze and posture will offer some insight here. A first gloss of the phenomenon suggests that in some cases one participant will be in disagreement and the remaining two participants will converge their attention with the person in disagreement. At other times, the person in disagreement will converge their attention on the perspective of the others'. Understanding this shared knowledge seeking behaviour when the majority of the group members are in agreement may offer insight into group dynamics at a micro level of detail.

In conclusion, we have established a block building task environment to encourage sharing and producing knowledge, with objects as central to the action. A multimodal (inter)action analysis shows that participants converge gaze and posture just prior to solving troublesome block-placement issues. Our analysis shows that participants' gaze orientation is responsive to the particulars of the task (Rossano, 2009,2012), rather than following norms observed in 'typical' face-to-face conversation (Goodwin, 1980). Furthermore, participants prioritise communicative intersubjectivity, by looking towards the same structure, over perceptual intersubjectivity, by looking towards different structures which would offer the same visual perspective to each participant. We suggest that converging gaze

and posture allow participants to go beyond their individual perspective of the task, to create shared knowledge and facilitate progress. This programme of research offers several pathways. One particularly interesting pathway includes exploring how modal configurations of shared knowledge are produced in a variety of task environments and exploring in more detail the different antecedents of converging attention.

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Figure 1: First excerpt showing participants reaching agreement



Figure 2: Second excerpt showing participants reaching agreement



